method of the variation of parameters, proper for determining directly the motion of the apses of an orbit.

III. "On some of the Products of the Distillation of Boghead Coal at low temperatures." By C. GREVILLE WILLIAMS, Esq., Assistant to Dr. ANDERSON, Professor of Chemistry in the University of Glasgow. Communicated by Dr. SHARPEY, Sec. R.S. Received May 14, 1856.

In presenting a brief preliminary notice of an investigation of the substances obtained by distilling boghead coal at low temperatures, I may observe that I was induced to undertake it from remarking the low density of the naphtha produced in the process; it being only ·750 at 60° F., although its boiling-point, previous to the rectifications, was as high as 290° F.

After fifteen complete fractionations of the portion distilling below 310° F., boiling-points were obtained as low as 170°, and it was found that the fluid could be separated, by careful treatment with fuming nitric, or a mixture of nitric and sulphuric acids, into two bodies, one forming a nitro-compound, the other being unacted on. The latter was washed several times with a strong alkaline solution, and, after being digested for a few days with sticks of potash to remove adherent moisture, rectified over sodium. In this manner I obtained a colourless and very mobile fluid with a pleasant odour, distantly resembling that of hawthorn blossoms. Its density at 60° was ·725.

I selected the fraction boiling in the fifteenth rectification at 240° F. to make a preliminary experiment upon, and, after purification in the manner described, it gave in three perfectly concordant analyses, exactly the per-centage of carbon and hydrogen required for butyl (valyl of Kolbe), the radical of the butylic alcohol. Two determinations of the vapour density, taken respectively at 80° and 107° above its boiling-point, gave numbers closely coinciding with theory.

When it is considered that 68° or more of difference of boiling-point only cause a variation of 0·3 in the per-centage of carbon and hydrogen of bodies of this class, it becomes evident that if I had

taken the fraction boiling at 223° (Wurtz) or 226° (Kolbe), it would have yielded the same results. This point is now under examination.

The formula

$$C^{16}\,H^{18}=4 \text{ vols.},$$

corresponds not only to butyl, but also to the hydruret of caprylyl, and, of course, both these bodies have the same vapour density; but several circumstances lead me to believe the hydrocarbon I have obtained to be the radical of the butylic alcohol. The density of the fluid, and the temperature at which it distils, are also rather in favour of this view. It will be seen that 247° F. should be the boiling-point of butyl if Frankland's determination of that of amyl be correct, and Kopp's law hold with these bodies.

A careful study of the papers already published on the radicals of this series, shows that more than one anomaly appears to exist in their physical properties, the gradations usually observed in homologous groups not being so distinctly marked as with most others, and this fact somewhat impedes their identification. The large quantity of substance which becomes at our disposal from the source mentioned, will, by facilitating the study, throw light on these points.

I believe I shall be able to isolate at least four of the radicals, viz. propyl, butyl, amyl, and caprotyl, from the coal distillate. The per-centage composition varying so little with the different homologues, I rely chiefly on vapour density and products of decomposition as the means of proving their presence.

The hydrocarbons accompanying the radicals are also quite distinct from the benzole series, as shown by the low density of the nitro-compound. The latter is extremely difficult of reduction by sulphide of ammonium or protacetate of iron, but it furnishes a volatile oily alkaloid by distillation with an alcoholic solution of potash.

The tedious purifications and the numerous operations required before the substances can be obtained in a state of sufficient purity for analysis from the coal distillate, will probably cause a considerable period to elapse before a detailed account of all the bodies can be published.